Society has 120 members, a capital of 1638*l.*, a library, and a physical laboratory, mostly of instruments presented by M. Bazilevsky. As to the scientific communications made to the Society, they are of great value, as will be seen from the following brief summary.

The first rank among them belongs to the researches of Prof. Mendeléeff, which are nearly all connected with his extensive work on the elasticity of gases, these last leading him to a great number of collateral researches, and to the invention of new methods and instruments. Such are, for instance, his communications:—1. On a differential naphtha-barometer intended to show small changes of pressure. 2. On a levelling instrument, being a modification of the former, and easily showing changes of level of one metre; it might be applied also to the measurement of the changes of density of air; an entire memoir was written by M. Mendeléeff to describe this apparatus, which is susceptible of so many applications. 3. On a means of boiling mercury in barometers. 4. On a new siphon-barometer, which is, so to say, a combination of two siphon barometers connected together in their upper parts, one of the two tubes being capillary, and serving to exhaust the air which may penetrate Torricelli's vacuum, and for filling the instrument with mercury. 5. On a mercury pump which eliminates the disadvantages of friction. 6. On a very sensitive differential thermometer. 7. On a formula of expansion of mercury from temperature: the volume at a temperature t being $= 100{,}000 + 17{\cdot}99\ t + 0{\cdot}002112\ t^2$, where 100,000 represents the volume at zero. 8. On the coefficient of expansion of air; the experiments were made with great accuracy, and the volumes measured by the weight of mercury; the coefficient was found to be $\alpha = 0{\cdot}0036843$. 9. On the temperature of the upper strata of the atmosphere; according to the measurements of Mr. Glaisher, Prof. Mendeléeff found that the increase of temperature (t) is equal to the increase of pressure (H); that is, $\frac{d\,t}{d\,H} =$ *Const.*, or $t = C + H\frac{t_0 - C}{H_0}$. Taking, then, into account the influence of moisture, Prof. Mendeléeff deduced, from the laws of the mechanical theory of heat, a formula which better agrees with observations than the formula of Poisson, deduced for dry air. An accurate knowledge of the law of changes of temperature in the upper parts of the atmosphere having an immense importance for meteorology, astronomy, and cosmography, Prof. Mendeléeff elaborated a thorough scheme of aërostatic observations in Russia. 10. On a general formula for gases; instead of the well-known formulæ of Clapeyron, he proposes the following, which embodies the laws of Marriott, Gay-Lussac, and Avogadro:—$A\ P\ V = K\ M\ (C + T)$, where M is the weight of the gas in kilogrammes, and A – its molecular weight, the atomic weight of hydrogen being taken as unity; K is a constant for all gases, whilst the R of Clapeyron varies with the nature and mass of the gas. 11. On the compressibility of air under pressures less than that of the atmosphere; the chief results for pressures from 650 millimetres to 0·5 millimetre are: the law of Marriott not only is not true for low pressures, but the disagreement increases as the pressure decreases; the produce $P\ V$ (pressure multiplied by the volume), at pressures from 0·5 to 650 millimetres, *increases* for the air approximately from 100 to 150, instead of decreasing, as resulted from Regnault's measurements under higher pressures. This result was so unexpected and so contrary to current opinion that the measurements were repeated many times and by different methods, but the result was always the same. So it must be inferred (to use Prof. Mendeléeff's own words) "that as the rarefaction of gases goes on, a maximum volume, or limit volume, is reached, like the minimum or limit volume reached at compression; therefore it cannot be said that a gas, when rarefied, merges into luminous ether, and that the atmosphere of the earth has no limits." The rarefied gas becomes, so to speak, like a solid body. If the pressure on a solid is diminished its volume increases, but at a pressure equal to zero it still attains a limit volume. There are many other communications of less importance which were made also by Prof. Mendeléeff.

Some communications by M. Kraevich were also connected with the same subject. He made investigations into the degree of rarefaction reached in mercury-pumps; into the luminous phenomena in Geissler tubes; into the dissociation of sulphuric acid and glycerine in vacuum, and so on. A special interest is attached to his preliminary experiments on rarefied air by a new method, which experiments lead to the conclusion that "after a certain limit of rarefaction the elasticity decreases much more rapidly than the density, and at a very great degree of rarefaction the air loses its elasticity." These experiments would thus confirm the researches of Prof. Mendeléeff.—M. Kraevich has described an improved barometrograph, a portable barometer, and a mercury-pump of his own invention.

Several improvements of the barometer were proposed, too, by MM. Shpakovsky, Gu'kovsky, Reinbot, and others. M. Lachinoff has proposed a mercury-pump without cocks. To the same department belong also the researches by M. Rykacheff into the resistance of the air; by M. Eleneff, on the coefficients of compressibility of several hydrocarbons; by M. Sreznevsky, on the evaporation of water-solutions of the chlorate of zinc; and by M. Schiff, on the compression of indiarubber cylinders.

In mechanics and mechanical physics M. Hesehus notices the works, by M. Bobyleff, on the weighing methods of Borda and Gauss; on the length of the seconds-pendulum at Kharkoff, by M. Osiroff, and several other communications by MM. Bobyleff, Schiller, Lapunoff, and Gagarin.

Calorific phenomena were the subject of many communications, we notice these: On the calibration of thermometers, by MM. Mendeléeff and Lermontoff; on the expansion of mercury and gases, by M. Mendeléeff; a formula of expansion of mercury and water, by M. Rosenberg; on the expansion of indiarubber, by M. Lebedeff; on a new method of determining the caloric conductibility of bodies by heating them at one end, by Prof. Petrushevsky; and several communications on the critical temperature, by MM. Avenarius, Jouk, and Strauss.

The communications on optics were numerous, and we notice among them the descriptions of an optical micrometer based on Newton's rings; and of a spectrophotometer, by Prof. Petrushevsky; the very interesting researches of M. Ewald on the phenomena of vision; the researches into the chemical action of light, by M. Lermontoff, who has tried to prove that light produces a dissociation of molecules and a new distribution of atoms whose return to their former distribution produces the phenomena of phosphorescence; several communications dealing with reflexion in mirrors; several papers on spectrum analysis; and researches dealing with photography.

The communications on electricity were as numerous as all the others taken together, the chief of them being: On the distribution of electricity on spheres under different conditions, and two other papers on electrostatics, of less importance, by M. Bobyleff; on the magnetisation of fine steel cylinders, by M. Khivolson, who has proposed a theory of residual magnetism, explaining these phenomena by the influence of molecules of carbon, which prevent to some extent the rotation of the molecules of iron; researches by M. Van der Flith on the mechanism of the interior and exterior phenomena of the current, which are explained by the molecular rotation in the circuit and by the breaking of equilibrium in the surrounding ether; the papers on thermoelectricity by Prof. Petrushevsky and M. Borgman, and several other papers by M. Borgman, Prof. Lenz, and Prof. Umoff; the microscopical researches into the crystallisation of the metal of electrodes, by M. Shidlovsky; and many others which it would be impossible to enumerate in this note. It will be sufficient to mention that the number of proposed electrical apparatus, as well as of papers on electro-technics, was very great, and some of them were of great value.

Cosmical physics was represented by most valuable papers on the resisting medium in space, by M. Asten; on the transits of Venus and Mercury, on variable and double stars, and on the parallax of refraction, by M. Glasenap; on the tails of the comets *b* and *c*, 1881, by Prof. Bredikhin; and by several interesting communications of MM. Woeikoff, Mendeléeff, Rykacheff, Schwedoff, and many others.

SOCIETIES AND ACADEMIES

London

Royal Society, March 1.—"Contributions to the Chemistry of Storage Batteries," by E. Frankland, D.C.L., F.R.S.

1. *Chemical Reactions.*—The chemical changes occurring during the charging and discharging of storage batteries have been the subject of considerable difference of opinion amongst chemists and physicists. Some writers believe that much of the storage effect depends upon the occlusion of oxygen and hydrogen gases by the positive and negative plates or by the active material thereon; some contend that lead sulphate plays an important

part; whilst others assert that no chemical change of this sulphate occurs either in the charging or discharging of the plates.

To test the first of these opinions, I made two plates of strips of thin lead twisted into corkscrew form, and after filling the gutter of the screw with minium, so as to form a cylinder that could be afterwards introduced into a piece of combustion-tubing, these plates were immersed in dilute sulphuric acid and charged by the dynamo-current in the usual manner. The charging was continued until the whole of the minium on the + and − plates respectively was converted into lead peroxide and spongy lead, and until gas bubbles streamed from the pores of the two cylinders.

After removal from the acid the plates were superficially dried by filter-paper, and immediately introduced into separate pieces of combustion-tubing previously drawn out at one end, so as to form gas delivery tubes. The wide ends of these tubes were then sealed before the blowpipe, care being taken not to allow the heat to reach the inclosed cylinders. The tube containing the cylinder of reduced lead was now gradually heated until the lead melted, the drawn-out end of the tube meanwhile dipping into a pneumatic trough. The gas expelled from the tube consisted almost exclusively of the expanded air of the tube and contained mere traces of hydrogen.

The tube containing the cylinder of lead peroxide was similarly treated, except that the heat was not carried high enough to decompose the peroxide. Mere traces, if any, of occluded oxygen were evolved.

These results justify the conclusion that occluded gases play practically no part in the phenomena of the storage cell.

With regard to the function of lead sulphate in storage batteries, I have observed that during the so-called "formation" of a storage cell a very large amount of sulphuric acid disappears from the liquid contents of the cell: indeed, sometimes the whole of it is withdrawn. The acid so removed must be employed in the formation of insoluble lead sulphate upon the plates which, in fact, soon become coated with a white deposit of the salt, formed equally upon both positive and negative surfaces. This visible deposit is, however, very superficial, and does not account for more than a very small fraction of the acid which actually disappears from solution. The great bulk of the lead sulphate cannot be discovered by the eye, owing to its admixture with chocolate-coloured lead peroxide.

Unless the coated plates have been previously immersed for several days in dilute sulphuric acid, this disappearance of acid during their "formation" continues for ten or twelve days. At length, however, as the charging goes on the strength of the acid ceases to diminish and soon afterwards begins to augment. The increase continues until the maximum charge has been reached and abundance of oxygen and hydrogen gases begin to be discharged from the plates; that is to say, until the current is occupied exclusively, or nearly so, in the electrolysis of hexabasic sulphuric acid expressed by Burgoin in the following equation:—

$$\underset{\text{Sulphuric acid.}}{SO_6H_6} = \overbrace{\underset{\text{Sulphuric anhydride.}}{SO_3} + 3O}^{\text{Eliminated on + plate.}} + \overset{\text{Eliminated on − plate.}}{3H_2}.$$

Of course the sulphuric anhydride immediately combines with water and regenerates hexabasic sulphuric acid:—

$$SO_3 + 3OH_2 = SO_6H_6.$$

On discharging the cell the specific gravity of the acid continually decreases until the discharge is finished, when it is found to have sunk to about the same point from which it began to increase during the charging. Hence it is evident that during the discharge the lead sulphate, which was continuously decomposed in charging, was continuously reformed in discharging.

The chief if not the only chemical changes occurring during the charging of a storage battery, therefore, appear to be the following:—

1st. The electrolysis of hexabasic sulphuric acid according to the equation already given.

2nd. The reconversion of sulphuric anhydride into sulphuric acid.

3rd. The chemical action on the coating of the + plate.

$$\underset{\text{Lead sulphate.}}{SO_4Pb} + O + 3OH_2 = \underset{\text{Lead peroxide.}}{PbO_2} + \underset{\text{Hexabasic sulphuric acid.}}{SO_6H_6}.$$

4th. The chemical action on the coating of the negative plate:—

$$\underset{\text{Lead sulphate.}}{SO_4Pb} + H_2 + 2OH_2 = Pb + \underset{\text{Hexabasic sulphuric acid.}}{SO_6H_6}.$$

If I have correctly described these changes, the initial action in the charging of a storage cell is the electrolysis of hexabasic sulphuric acid, each molecule of which throws upon the positive plate three atoms of oxygen, and upon the negative plate six atoms or three molecules of hydrogen. Each atom of oxygen decomposes one molecule of lead sulphate on the positive plate, producing one molecule of lead peroxide, and one of sulphuric anhydride, the latter instantly uniting with three molecules of water to form hexabasic sulphuric acid.

The following are the chemical changes which I conceive to occur during the discharge of a storage cell:—

1st. The electrolysis of hexabasic sulphuric acid as in charging.

2nd. The reconversion of sulphuric anhydride into hexabasic sulphuric acid as already described.

3rd. The chemical action upon the coating of what was before the positive plate or electrode, but which now becomes the negative plate of the cell, that is to say, the plate from which the positive current issues to the external circuit:—

$$\underset{\text{Lead peroxide.}}{PbO_2} + H_2 = \underset{\text{Lead oxide.}}{PbO} + \underset{\text{Water.}}{OH_2}.$$

The lead oxide thus formed is immediately converted into lead sulphate:—

$$PbO + SO_6H_6 = SO_4Pb + 3OH_2.$$

4th. The chemical action upon the coating of what has now become the positive plate of the cell:—

$$Pb + O + SO_6H_6 = SO_4Pb + 3OH_2.$$

Thus in discharging, as in charging, a storage cell, the initial action is the electrolysis of hexabasic sulphuric acid. The oxygen eliminated on the positive plate reconverts the reduced metal of that plate into lead oxide, whilst the hydrogen transforms the lead peroxide on the negative plate into the same oxide, which in both cases is immediately converted into lead sulphate by the surrounding sulphuric acid, thus restoring both plates to their original condition before the charging began.

The real "formation" of the cell consists, I conceive, in the more or less thorough decomposition of those portions of the lead sulphate which are comparatively remote from the conducting metallic nucleus of the plate. Lead sulphate itself has a very low conductivity, whilst lead peroxide, and especially spongy lead, offers comparatively little resistance to the current, which is thus enabled to bring the outlying portions of the coating under its influence. It may be objected that, during the discharge, the work of formation would be undone; but probably, in the ordinary use of a storage battery, the discharge is never completed. Thus I have found that, in a small cell containing two plates 6″ × 2″, short circuiting with a thick copper wire for twelve hours was far from producing complete discharge, for on breaking this short circuit the cell *instantly* rang violently an electric bell with which it was previously connected. In ordinary discharges of "formed" cells, therefore, the lead sulphate on the positive and negative plates still remains mixed with sufficient lead oxide and spongy lead respectively to give it a higher conducting power than the sulphate alone possesses.

2. *Chemical Estimation of the Charge in a Storage Cell.*—No method has hitherto been known by which the charge in a storage cell could be ascertained without discharging the cell; but the results of the foregoing experiments indicate a very simple means of ascertaining the amount of stored energy without any interference with the charge itself. The specific gravity and consequent strength of the dilute sulphuric acid of a "formed" cell being known in its uncharged and also in its fully charged condition, it is only necessary to take the specific gravity of the acid at any time in order to ascertain the proportion of its full charge which the cell contains at that moment; and if the duty of the cell is known, the amount of energy stored will also be thereby indicated. In the case of the cell with which I have experimented, containing about seven quarts of dilute sulphuric acid, each increase of ·005 in the specific gravity of the dilute acid means a storage of energy equal to 20 amperes of current for one hour, obtainable on discharge.

I hope shortly to be able to express, in terms of current from the cell, the definite relation between the amount of energy stored and the weight of sulphuric acid liberated.

Chemical Society, March 30.—Anniversary Meeting.—Dr. Gilbert, president, in the chair.—The President presented his annual report, in which he gives a review of the progress of the Society from the commencement of its existence in 1841 up to the present time. The Society numbers 1247 Fellows, with an income of about 3000*l*. During the past year 70 papers have been read, and a discourse delivered by Prof. Dewar. Grants in aid of research have been made of 220*l*. 1775 copies of the *Journal* were printed during the past year. The library contains 6800 volumes, and a new catalogue will shortly be issued to the Fellows. In his address the President gives a most interesting *résumé* of the arrangements for chemical education and research on the American Continent. After the usual votes of thanks the following Officers, &c., were balloted for and declared duly elected:—President, W. H. Perkin, Ph.D., F.R.S. Vice-presidents: F. A. Abel, Warren De La Rue, E. Frankland, J. H. Gilbert, J. H. Gladstone, A. W. Hofmann, W. Odling, Lyon Playfair, H. E. Roscoe, A. W. Williamson, A. Crum Brown, P. Griess, G. D. Liveing, J. E. Reynolds, E. Schunck, A. Voelcker. Secretaries: H. E. Armstrong, J. Millar Thomson. Foreign Secretary, Hugo Müller. Treasurer, W. J. Russell. Council: E. Atkinson, Capt. Abney, H. T. Brown, W. R. E. Hodgkinson, D. Howard, F. R. Japp, H. McLeod, G. H. Makins, R. Meldola, E. J. Mills, C. O'Sullivan, C. Schorlemmer.

Meteorological Society, March 21.—Mr. J. K. Laughton, F.R.G.S., president, in the chair.—The following gentlemen were elected Fellows of the Society: viz. Mr. G. T. Hawley, Dr. C. W. Siemens, F.R.S., Mr. C. Walford, F.S.S., and Col. H. G. Young. Dr. W. Köppen was elected an Honorary Member.—The paper read was notes on a march to the hills of Beloochistan, in North-West India, in the months of May to August, 1859, with remarks on the simoom and on dust storms, by Dr. H. Cook, F.R.G.S., F.M.S. These months may be considered as the summer of the hill-country of Beloochistan, though the natives expect the weather to change soon after the fall of rain, which takes place about the end of July and beginning of August. Compared with that of the plains, the climate is delightful. The actual heat is greater than in England, especially the intensity of the sun's rays, but the weather is less variable. Fruits and crops, as a rule, ripen earlier, and are not exposed to the vicissitudes of the English climate. The atmosphere is clear and pure, the air dry and bracing. Dr. Cook describes different kinds of dust-storms, and considers that they are due to an excess of atmospheric electricity. With regard to the simoom, which occurs usually during the hot months of June and July, it is sudden in its attack, and is sometimes preceded by a cold current of air. It takes place at night, as well as by day, its course being straight and defined, and it burns up or destroys the vitality of animals and vegetable existence. It is attended by a well marked sulphurous o'our, and is described as being like the blast of a furnace, and the current of air in which it passes is evidently greatly heated. Dr. Cook believes it to be a very concentrated form of ozone, generated in the atmosphere by some intensely marked electrical condition.—After the reading of this paper the Fellows inspected the exhibition of meteorological instruments for travellers, and of such new instruments as had been constructed since the last exhibition. In addition to the ordinary instruments designed for travellers, viz. barometers, thermometers, hypsometrical apparatus, compasses, artificial horizons, &c., some very interesting historical instruments used by celebrated travellers and explorers were exhibited, including those used by Dr. Livingstone in his last journey; by Commander Cameron during his journey across Africa; by Sir J. C. Ross in his Antarctic Expedition; by Sir E. Sabine, in his Arctic voyage, &c.

Zoological Society, March 20.—Prof. W. H. Flower, F.R.S., president, in the chair.—Mr. Sclater called attention to the fact that a living specimen of *Macropus erubescens* (a species originally described from a single specimen living in the Society's Gardens) was in the Gardens of the Zoological and Acclimatisation Society of Melbourne.—Mr. Sclater laid before the meeting a set of the sheets of a new List of British Birds which had been prepared by a Committee of the "British Ornithologists' Union," and would shortly be published, and explained the principles upon which it had been constructed.—Prof. Huxley read a paper on the oviduct of the Common Smelt (*Osmerus eperlanus*), and took occasion to remark on the relations of the Teleostean with the Ganoid fishes. Prof. Huxley came to the conclusion that the proposal to separate the Elasmobranchs, Ganoids, and Dipnoans into a group apart from and equivalent to the Teleosteans was inconsistent with the plainest anatomical relations of these fishes.—Mr. G. A. Boulenger read a paper containing the description of a new species of Batrachian of the genus *Bufo* obtained at Yokohama, Japan, during the expedition of H.M.S. *Challenger*. The author proposed to describe it as *Bufo formosus*.—A communication was read from Mr. W. N. Parker containing some notes on the respiratory organs of *Rhea macrorhyncha*, and comparing these organs with those of the Apteryx and Duck.

Royal Horticultural Society, March 27.—Sir J. D. Hooker, K.C.S.I, in the chair.—*Sclerotia of Peronospora infestans*: Mr. W. G. Smith called attention to the fact that the so-called "sclerotia," described in a paper by Mr. A. Stephen Wilson, read at the last meeting, were observed and figured by Von Martius so long ago as in 1842 ("Die Kartoffel Epidermie") as Protomyces and by Berkeley as Tubercinia in his paper on the Potato Murrain, in the first volume of the *Hort. Soc. Journal*, 1846. They were subsequently figured by Broome in 1875, and by Prof. Buckman. Mr. G. Murray said that from his examination they often seemed to consist of the discoloured and disorganised contents of the cells, which they completely filled, though in Martius's drawing two or three were in one cell; Dr. Masters, however, noticed that they are often *outside* the cells and of an angular character, as if they had not assumed the form of the interior of a cell. The question was raised whether they might not have been expressed by the covering glass. Martius figured them with conidiferous threads proceeding apparently in abundance from them. Further investigation of their true nature was thought desirable.—*Abutilon* and *Hibiscus* "bigener": Dr. Masters described a very dark-flowered Abutilon which was said to be due to an original cross between *H. Rosa-sinensis* and *A. striatum*. The original plant was a dark-flowered seedling which was fertilised by Mr. George of Putney for two or three generations with the pollen of the Hibiscus, and though the character of the flower is that of an Abutilon, it has the truncated column and foliage of the Hibiscus, thus showing distinctly intermediate characters. In one plant the leaves were marked with a dark crimson spot. Hence it appears to be a true bigener, or cross between two distinct genera.—*Ivy-leaved Pelargonium Cross*: Mr. George sent some foliage of a cross between the ivy-leaved and a rough-leaved Pelargonium. Several showed a reversion to the peltate type, some assuming a funnel-shape or other irregular form, thus betraying its origin from *P. peltatum*.—*Orange-trees attacked by Mytilaspis citricola*, one of the Coccidæ: Mr. Maclachlan exhibited leaves and branches of oranges much injured by this insect from the Bahamas. He read a communication by Messrs. Dunlop and Roker communicated by the Governor to the British Government, requesting information. The insect was therein named *Aspidites Gloverii*. He made some remarks on the method of attack of the insect, and suggestions as to remedies to suppress it, such as washes and syringing with petroleum and the use of whale-oil soap.—*Solanum species*: Sir J. D. Hooker read a communication from Mr. Lemmon, of Oakland, California, upon the discovery of three species or varieties of Solanum bearing tubers, from the borderland of Arizona and Mexico:—"We found them first," writes the author, "on the cool northern slopes of the high peaks [of the Huachuca range]; then afterwards, where least expected, invading the few rudely cultivated gardens of the lower foothills. One kind is called *S. Jamesii*, Tor., in the "Survey of the Mexican Boundary." This has white flowers and tubers. Another was *S. Fendleri*, Gr. It has smaller purple flowers and flesh-coloured tubers. This Dr. Gray lately concludes to be but a variety of the old Peruvian potato, and he calls it *S. tuberosum*, var. *boreale*. The third form or species found at 10,000 feet altitude has mostly single orbicular leaves, one or two berries only to the umbel, and small pink tubers on long stolons, growing in loose leaf-mould of the cool, northern forested slopes. . . . I have great faith in the successful raising of one of these species (or varieties) to a useful size, for the following reasons:—1. While the *S. tuberosum*, var. *boreale*, bears long stolons and but a few tubers, the other kind, *S. Jamesii*, makes many short stolons terminated by four to eight large, round white tubers. 2. While the first kind has been partially tried and then given up, the latter species is known to have become enlarged to the size of domestic hens' eggs during the accidental cultivation of three years in the embanking of a rude fish-pond."

EDINBURGH

Royal Society, March 19.—Prof. Maclagan, vice-president, in the chair.—Mr. Sang read a paper on the impossibility of inverted images in the air, in which he discussed the conditions as to density necessary for such an effect, concluding that these atmospheric conditions were so unstable as to make it physically impossible for clear images to be formed. The famous observation by Vince of the erect and inverted images high up in air was, he maintained, simply the case of a vessel and its reflection in the sea, which was so calm as to be indistinguishable from the sky—the *apparent* horizon being the margin of a ruffled portion of the surface between the true horizon and the observer.—Prof. Tait communicated a note on the thermoelectric positions of pure rhodium and iridium, specimens of which had been supplied him by Messrs. Johnson and Matthey. The lines of these metals on the thermoelectric diagram were found to be parallel to the lead line, that is, according to Le Roux, the Thomson effect is *nil* in them. Unfortunately the lines are too close to be of any practical use as a thermoelectric thermometer.—Dr. Christison gave the results of the observations on the growth of wood in deciduous and evergreen trees, which had been begun by the late Sir Robert Christison in 1878, and continued by himself since Sir Robert's death. It appeared that the evergreen trees began their rapid growth much earlier in the year than the deciduous trees, and stopped sooner. Hence the reason why the variations in growth in successive years did not follow the same law in these two classes—an early winter affecting the deciduous trees, a late winter the evergreen. The effect of wet seasons was also indicated, the deciduous trees being apparently more influenced.—Mr. Buchan read a paper on the variation of temperature with sunspots. The comparison was not a direct one, but was based upon the well-known phenomenon of the diurnal barometric oscillation viewed in relation to the amount of water vapour in the air. From the observations of the *Challenger* Expedition, Mr. Buchan had concluded that this diurnal variation over the open sea was not the result of changes of surface temperature (for these were very small), but was to be referred to the direct heating effect of the sun upon the air, or more strictly upon the water vapour in the air. This view was supported by the fact that over the sea the diurnal variation of pressure was greatest where most vapour was; whereas the contrary held over the land, the temperature of which varied greatly during the day, and the more so when the air above was drier, as more heat then reached the earth. In other words, the increase of moisture in the air increases the barometric oscillation over the sea and diminishes it over the land; and hence it seemed probable that the discussion of these daily oscillations in sun-spot cycles might lead to some definite result. The long-continued observations at Calcutta, Madras, and Bombay were combined in this way, and yielded a remarkable result—there being a well-marked maximum of barometric diurnal oscillation half way between the minimum and maximum sun-spot years, and a minimum half way between the maximum and minimum years. The averages were taken for the five dry winter months, and the effects were explained as due to the accumulated water vapour in the upper southerly winds that exist over India during these months. When the rainfall on the southern slopes of the Himalayas was similarly treated—which rainfall is of course due to the arresting of these upper moist currents—the analogous fact was brought out, viz. minimum rainfall at times of maximum barometric oscillation and *vice versâ*.

DUBLIN

Experimental Science Association, March 13.—On Ayrton and Perry's voltmeter, by Prof. Fitzgerald.—On an experiment on the resonance of flames, by H. Maxwell. A vibrating tuning fork when held in a gas or candle flame, or in the heated current of air above, was shown to have its note greatly strengthened. A current of unignited gas produced no perceptible strengthening of the note.—A thermal galvanoscope, by C. D. Wray. A method of showing to an audience the expansion of a wire under the heating influence of a current of electricity.—On a thermometer that can be read by telegraph, by J. Joly. An arrangement whereby the level of the mercury in a thermometer can be read by reckoning the number of contacts made with a battery in the home station. Suitable mechanism on the thermometer causes a wire to advance down the open tube of the thermometer, by a known minute distance, at each passage of the current. On reaching the mercury, a current passes to a galvanometer in the home station.

SYDNEY

Linnean Society of New South Wales, January 31.—C. S. Wilkinson, F.G.S., president, in the chair.—The following papers were read:—On a new form of mullet from New Guinea, by William Macleay, F.L.S., &c. This is a description of a very remarkable freshwater fish from the interior of New Guinea, allied to Mugil, but constituting a new genus to which the author gives the name of *Æschrichthys*.—By J. J. Fletcher, M.A., B.Sc. The second part of his paper upon the anatomy of the urogenital organs in females of certain species of Kangaroos.—On remains of an extinct Marsupial, by Chas. W. De Vis, B.A. This is a very careful description of a number of bones found together and evidently of the same individual, by Mr. Henry Tryon, in Gowrie Creek, Darling Downs. The bones and teeth point to some bilophodont form, showing affinity with *Macropus* and *Palorchestes* on the one hand, and with *Nototherium* and *Diprotodon* on the other.—Contributions to the ornithology of New Guinea, by E. P. Ramsay, F.L.S., &c. This contained a complete list of the birds recently brought by Mr. Goldie and others from the south-east part of the island.—On a new species of Tree Kangaroo from New Guinea, by the same author. This differs from *Dendrolagus venustus* in some particulars, and is named after the Marquis Doria. A new Rat (*Hapalotis Papuanus*) was also described.—On some habits of *Pelopœus lætus* and a species of *Larrada*, by Mr. H. R. Whittell.—Mr. Whittell also read a short paper on the voracity of a species of *Heterostoma*. He had observed one of these centipedes in the act of eating a live lizard. The aggressor, evidently finding his victim too powerful for his unassisted strength, had ingeniously taken a double turn with the posterior portion of his body around a small stem which was found conveniently at hand, and so was enabled to continue his meal without interruption.

BERLIN

Physical Society, March 2.—Prof. Kirchhoff in the chair.—Dr. König reported on two optico-physiological researches, which he had carried out in consequence of his optical studies with the leucoscope. In the first he has, with the aid of a special apparatus, examined a number of colour-blind persons as to the position in the spectrum of their so-called "neutral" point. According to the Young-Helmholtz theory, it is known, there are three primary colours (red, green, and violet), each of which produces its special colour-sensation, while all combined give the impression of white. The sensibility for the three primary colours is so distributed over the spectrum that their curves in great part coincide on the abscissa of wave-lengths, and therefore mixed colour-sensations occur everywhere, while the maxima of the separate curves occur at the places of brightest red, green, and violet respectively. In the case of the colour-blind one curve is wanting, and the two remaining ones have therefore a point of section where their ordinates are the same. Hence the eye must at this part have the impression of white or grey. For finding this neutral point in the spectrum, an apparatus served, in which the telescope of a spectroscope was so arranged with regard to the non-refringent angle of the prism that the spectrum took up only half of the field of vision, while the other half was occupied with the image of the white-painted ground-surface of the prism. Instead of the eyepiece there was another slit in the telescope, in which one saw only a small section of the spectrum; by micrometric displacement of the collimator of the spectral apparatus any part of the spectrum could be brought on the slit. Now at a particular part of the spectrum the colour-blind person saw both halves of the field of vision white, while the person with normal vision saw the part of the spectrum in question in its normal colour, and so could determine the wave-length at which the neutral point of the colour-blind person occurred. Changes of light-intensity displaced the neutral point; hence in comparative measurements care must be taken to have the same intensity in the source of light. Such measurements were made by Dr. König with great precision on nine colour-blind persons, and it appeared that the neutral points are situated between about 491 and 500 millionths of a millimetre, and (what is of special interest theoretically) that the mean values of the separate observations with different colour-blind persons were not equal, but varied in a pretty regular series between the two terminal values. According to the common view that colour-blindness depends on the disappearance of one of the normal three curves of colour-perception, the position of the neutral point as point of section of the two curves present must be always the same, and for the

red and the green blind must be at two quite determinate points of the spectrum. As the experiments have yielded a different result in persons, two of whom were red-blind, and seven green-blind, Dr. König believes that the essence of colour-blindness consists not in the absence of one curve, but in the displacement of two curves on one another, which may be more or less complete, and so produces the different degrees of colour-blindness observed. In the second investigation Dr. König sought to determine the two remarkable points of section of the three curves that occur, according to the Young-Helmholtz theory, in normal colour-perception. From the researches of Prof. von Helmholtz on the wave-lengths of the complementary colours, and from those of Clerk Maxwell on colour-mixtures, appear values for these points of section which agree pretty well. The same values, approximately, are reached by the researches of several ophthalmologists on the places of quickest change of colour in the spectrum. Dr. König tried to determine the first section point by making the violet curve disappear through the taking of santonin, and when he had thus made himself temporarily violet-blind, he determined his neutral point, the point of section of the red and the green curve. All these determinations and theoretical considerations led to pretty much the same values for the points of section, and the first point is situated not, as is often supposed, in the yellow, but in the blue, between the Fraunhofer lines E and b_1, and nearer the latter.

Paris

Academy of Sciences, March 26.—M. Blanchard in the chair.—The following papers were read:—On an objection of M. Tacchini relative to the theory of the sun in the *Memorie dei Spettroscopisti Italiani*, by M. Faye. Having observed the eruptions accompanying a spot to be intermittent and of brief duration, M. Tacchini thinks this fact against the theory of the spots being due to cyclonic movements. M. Faye says this is as if, on seeing the water-jet of a force-pump go down, one maintained that the pump did not exist.—Contribution to the study of stamping and of the "prows" it produces, by M. Tresca.—On the motion and deformation of a liquid bubble which rises in a liquid mass of greater density, by M. Resal.—Note on the preparation of oxide of cerium, by M. Debray.—On the reading of a report by M. d'Abbadie on his transit expedition to the island of Haiti, the president expressed the felicitations of the Academy (concern had been felt on account of the prevalence of yellow fever).—Addition to preceding communications on continuous periodic fractions, by M. de Jonquières.—Character by which one may perceive if the operation indicated by

$$\sqrt[2m+1]{a\sqrt{v} \pm b\sqrt{wi}}, \text{ or by } \sqrt[2m]{a \pm b\sqrt{vwi}},$$

may be effected under the form $\alpha\sqrt{v} \pm \beta\sqrt{wi}$, m designating a positive whole number, v and w positive rational numbers, and a and b, α and β any rational numbers; method of effecting this operation, by M. Weichold.—On a spectroscope with inclined slit, by M. Garbe. He described to the French Physical Society on March 2 an arrangement similar to M. Thollon's.—Observation on the figures of consumption of zinc given by M. G. Trouvé for his bichromate of potash batteries, by M. Regnier. He points out a difference between the effective and the theoretical expenditure.—Heat of formation of glycolates, by M. de Forcrand.—Action of sulphur on oxides, by MM. Filhol and Senderens. Sulphur acts on alkalies in the dissolved state less and less easily the greater the dilution.—On the action of different varieties of silica on lime water, by M. Landrin. Hydraulic silica, gelatinous silica, and soluble silica absorb lime water more or less rapidly, but in all cases the absorption finally varies, for one equivalent of silica, between the limits 36 and 38. The formula $3SiO_2,4CaO$, requiring for 30 of silica 37·3 of lime, thus fairly expresses the limit towards which those phenomena tend.—On the hydrate type of neutral sulphate of alumina, by M. Marguerite-Delacharlonny.—On the production of bromised apatites and Wagnerites, by M. Ditte.—Researches on crystalline phosphates, by MM. Hautefeuille and Margottet.—On various effects of air on beer yeast, by M. Cochin. It is only some time after the glucose solution has penetrated, by endosmose, the membranous envelope of the yeast cells, that fermentation commences. Sometimes (yeast aërated) the sugary liquid simply penetrates into the yeast, the proportion of sugar outside continuing undiminished; sometimes (yeast deprived of air) the sugar is absorbed in larger quantity by the yeast and the liquid outside impoverished. It is within the cell that the sugar is transformed. Probably air attenuates ferments as it does virus.—Determination of extractive matters and of reducing power of urine, by MM. Etard and Richet. This determination is made with bromine; which in acid solution attacks the uric acid and the extractive matters. The reducing power of urine varies much in different individuals, but little in one individual.—The perception of colour and the perception of form, by M. Charpentier. Luminous rays have two distinct actions on the visual apparatus—one gives rise to the rudimentary perception of light and is distributed pretty equally over all points of the retina; the other is more efficacious on the centre of the retina, giving rise, on the one hand, to the sensation of colour, on the other to the distinction of multiple luminous points.—Note on the adherence of a frontal tumour with the yolk, observed in a cassowary which died in the egg at the moment of hatching, by M. Dareste.—New observations on the dimorphism of Foraminifera, by MM. Munier-Chalmas and Schlumberger.—Attempt at application of M. Faye's cyclonic theory to the history of primitive meteorites, by M. Meunier. He considers that chondrites are to rocks of gaseous precipitation what iron grains, &c., are to rocks of aqueous precipitation. They testify to eddies in the generating medium, to photospheric cyclones.—On shocks of earthquake observed in the department of La Mayenne, by M. Faucon. These were felt about 3 p.m. on March 8. Three considerable trepidations occurred in a few seconds.—M. Decharme described a method of preserving and reproducing crystalline forms of water. A horizontal glass plate at a low temperature is covered with a thin layer of water mixed with minium; particles of the minium are involved in the formation of ice. Ulterior fusion and evaporation leave the minium in position.

Vienna

Imperial Academy of Sciences, February 15.—C. v. Ettingshausen, contributions to the knowledge of the Tertiary flora of Australia.—F. Brauer, to nearer knowledge of the Odonatæ, genera Orchithemis, Lyriothemis, and Agrionoptera.—On the systematic position of the genus Lobogaster, Pil., by the same.—S. Tolver Preston, a dynamic explanation of gravitation.—On the possibility of explaining past changes in the universe by the action of natural laws now active, by the same.—E. Heinricher, contributions to the teratology of plants and morphology of flowers.—P. Pastrovich, on Reichenbach's picamar; on cœrulignol, Reichenbach's oxidating principle.—A. Tarolimek, on the relation between tension and temperature of saturated vapour.

March 1.—W. Biedermann, contributions to general nerve and muscle physiology (eleventh communication); on rhythmic contractions of striped muscles under the influence of constant currents.—V. Graber, fundamental experiments on the light and colour sensibility of eyeless and blinded animals.—P. R. Handmann, on a very useful filling of the zinc-carbon battery.

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